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An Electronic Daily Diary Study of Anal Intercourse in Drug-Using Women

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Abstract

Women (*N* = 138) with histories of illicit drug use were recruited into an electronic diary study that used Android smartphones for data collection. The diary was to be completed each day for 12 weeks using an “app” created in HTML5 and accessed over the Internet via smartphone. Data collection included information on sexual behaviors with up to 10 partners per day and contextual factors surrounding sexual behavior such as drug use before/after, type of sexual behavior (oral, vaginal, anal), and other activities such as using condoms for vaginal and anal intercourse and use of sexual lubricants. The sample was predominantly African American (58 %); 20 % Latina, 20 % White and 2 % reported as Other. Most women reported either less than a high school education (33 %) or having a high school diploma (33 %). The mean age was 39 years (*SD* = 11.78). Anal intercourse occurred on days when women also reported using illicit drugs, specifically methamphetamine and cocaine. Anal intercourse was not an isolated sexual activity, but took place on days when vaginal intercourse and giving and receiving oral sex also occurred along with illicit drug use. Anal intercourse also occurred on days when women reported they wanted sex. HIV prevention interventions must address the risks of anal intercourse for women, taking into account concurrent drug use and sexual pleasure that may reduce individual harm-reduction behaviors.

Keywords

Heterosexual anal intercourse; Women; Daily diary study; Electronic smartphone data collection

Introduction

Heterosexual receptive anal intercourse (HRAI) in women has been associated with illicit drug use both injected and non-injected [1–10], alcohol use, especially binge drinking [11, 12], sex trading [13, 14], sexually transmitted infections [15–23], and participation in drug

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treatment [24] in cross-sectional studies. Earlier age of sexual debut has also been associated with HRAI in women [25]. Cross-sectional studies are unable to ascertain the temporal context surrounding events that include both drug use and risky sexual behavior, and the sequencing of those behaviors because they can only provide macro level associations. For example, women who have ever taken methamphetamine are more likely to report anal intercourse [8]. But cross-sectional studies are not able to provide more precise temporal associations between positive prediction and risk precursors to outcome behaviors, such as anal intercourse. Anal intercourse is well-recognized as an human immunodeficiency virus (HIV) risk factor for women [15, 26–28], however HIV prevention messages and interventions for women seldom address risks associated with anal intercourse and continue to focus on vaginal intercourse [29].

The use of the Internet and Internet-based technologies have been used to gather information on sexual behavior in a wide variety of studies examining risks for HIV however, the majority have been conducted with men-who-have-sex-with-men (MSM) [30]. A recent review article details the use of the Internet, smartphones and texting by MSM for everything from seeking sex partners on-line to HIV prevention education and interventions [31]. Studies of HIV-positive individuals have used electronic and Internet technologies for medication adherence and sexual risk reduction [32].

Several studies of sexual behavior in women, though not focused specifically on drug-using women, have used Internet or smartphone-based approaches. These include studies of condom use among adolescent women [33, 34], hormonal contraception use [35], bleeding after intrauterine device insertion [36], hot flashes [37], pubic hair removal [38], prevalence of anal intercourse [39], prevalence of pain during anal intercourse, [40] and use of microbicides and other lubricants [41, 42]. Unlike the plethora of Internet-based studies of the intersection of drug use and sexual risk behaviors of MSM, far fewer of the Internet studies have focused on anal intercourse in women and its association with illicit drug use and other behaviors, using newer technologies. Event-level studies, in which data are collected on a much more intensive basis than cross-sectional studies, collect information concerning the context of sexual or drug using encounters by using daily diary data collection in which the data are entered very soon after the target event. Electronic data collection tools, such as smart phones, facilitate this self-disclosure of sex and drug use behaviors that are highly stigmatized [43, 44] and reduce recall bias because the data are entered on a micro or event level soon after the occurrence of the event. This increasing use of smartphones and other technology has also been termed “intensive longitudinal designs” and there are a large variety of research questions that can be addressed using these methods [45].

The purpose of this study was to investigate the temporal association between drug use and high-risk anal intercourse among women. We report on a smartphone-based data collection study that obtained daily diary data on both sexual behaviors and illicit drug use over a 12-week period from a sample of illicit drug-using women.

Methods

Women with a self-report of illicit drug use who were also of reproductive age (18–45 years) were recruited into an electronic diary study using Android smart phones for data collection. The diary was to be completed each day for 12 weeks using an “app” created in HTML5 and accessed over the Internet via the smart phone. Women were recruited into the study based on their self-report of current illicit drug use, being at least 18 years of age, and being a biological female. Women completed a baseline assessment which included the risk behavior assessment (RBA) [46–48] or risk behavior follow-up assessment (RBFA) [49].

After baseline data collection, women were provided with a description of the daily diary study, including the requirement that they complete the diary once per day for 12 weeks, and the incentive schedule. If the woman indicated a willingness to participate in the diary study after reviewing and signing the California State University, Long Beach Institutional Review Board (CSULB IRB)—approved informed consent form, she received an orientation to the Android smart phone and received training on how to access the diary collection site via the smartphone. These smartphones were provided by the study to participants and all costs of connectivity (unlimited talk, text and Internet access) were covered by the project. After orientation to the smartphone, the participants received a unique 6-digit identification number for logging into the site and a 4-digit PIN number. Completion of the daily diary included weekly incentives: the women received $5 each week for the first 8 weeks of diary completion, and $20 each week for weeks 9–12. Receipt of the weekly incentives was predicated on completion of the diary at least 4 out of every 7 days, however participants were encouraged to complete the diary every day so that it became part of their daily routine. An additional incentive was that the women got to keep the smart phone at the end of the study.

Daily diary data collection included information on mood, sexual behaviors with up to 10 partners per day and contextual factors surrounding the sexual behavior such as drug use before/after, type of sexual behavior (giving and receiving oral, vaginal, anal), and other activities such as using condoms for vaginal and anal intercourse and use of sexual lubricants. Participants also reported on daily drug use from a menu of drugs including alcohol, nicotine (cigarettes), marijuana, cocaine (powered), crack, methamphetamine, heroin, and were provided with an open response option to note any drug used that was not included in the list.

The diary study employed a mixed approach integrating both interval and event-contingent data collection [38]. The specific approach can be found in Bolger and Laurenceau [45]. For example, the participants were asked to complete the daily diary on an interval basis, for example, each day; the participant was not restricted as to when diary completion should take place as diary data could be uploaded to the server 24/7. If there were no interactions with sexual partners that day, then the participants completed the interval-contingent questions concerning their mood and affect, and behaviors they engaged in without sexual partners, such as cigarette, alcohol and drug use; they could also report on non-sexual daily activities. The event-contingent element was based on whether a participant had an encounter with a sexual partner. If the woman answered “yes” to having an interaction with

a sexual partner or multiple sexual partners on any given day, she also completed the questions concerning these encounters (drug use before or during sex, type of sexual behavior (giving oral sex, receiving oral sex, vaginal and/or anal intercourse) and whether a condom or lubricant was used). Women could report on encounters with up to 10 sexual partners each day.

All protocols were approved by the California State University Long Beach, Institutional Review Board. Informed consent for the study included three separate phases: the first covered the baseline questionnaire, for which participants received $25; the second was the diary study, for which participants received $5 for each of weeks 1–8, and $20 for each of weeks 9–12; and the follow-up interview for which participants received $40. Only those participants who completed all 12 weeks of the diary study were eligible for the follow-up interview. Women could be dropped from the study for failing to complete the daily diary for two full consecutive weeks. Text messages and reminders were routinely sent to participants if they did not complete the diary each day. Phones that were lost, broken, or reported stolen during the course of the study were not replaced and participants were withdrawn if any of these events occurred. These details were covered in the informed consent form for the diary study. The follow-up interview consisted of all questionnaires administered at baseline, plus a brief questionnaire asking women to rate their satisfaction with the daily diary study and the use of the smart phones, diary app and website. Once a woman was enrolled into the smart phone study and received the smart phone, research staff were available Monday through Friday for additional in-person training and answering questions. They were also available by telephone. The larger study's goal was to recruit 200 drug-using women into the daily-diary study.

The purpose of this paper is to report on the variation in anal intercourse among the participants. According to Bolger and Laurenceau [45] "each person in an intensive longitudinal study (e.g., daily diary study) contributes her own set of observations to the dataset" (p. 29). One person will exhibit variance in the responses she provides over the course of the intensive data-collection period. This is the within-subjects' part of the process. However, because data were collected from more than one participant in the same intensive (daily) longitudinal manner, a multi-level analysis must also allow for "the possibility that there are between-subjects differences on the dependent variable" (p. 26). In other words, the within-subjects aspect is "how did participants differ over time?" The between-subjects aspect is how did participants differ from each other. For purposes of this paper, we hypothesized a within-subjects process whereby anal intercourse would occur on days when a respondent also used illicit drugs.

Missing data were treated is if they were missing at random [50]. In diary studies, the majority of missing data occurs because a participant fails to complete an entire diary entry, therefore both the outcome and the predictor variables are missing [45]. This assumption provides valid inferences when maximum likelihood estimation procedures are used, as was the case in our analysis using MPlus.

The statistical analysis was conducted using MPlus for the multilevel analysis. Specific code for implementation in MPlus can be found in Bolger and Laurenceau (2013, p. 121). SAS

9.3 was used only to create Fig. 2 using the SAS output delivery system (ODS). Code for producing the between subjects variation graphs using the SAS ODS can be found in Bolger and Laurenceau [45] (p. 106).

Results

The majority of women were African American (58 %), followed by Latina (17 %), White (18 %), and Other/mixed race (6 %). Participants' mean age was 39.1 years (*SD* = 11.78), 34 % reported that they never finished high school, and 44 % reported a high school education or equivalent. Table 1 provides demographic information on the participants. Zero participants had any prior experience using a smart phone prior to enrollment in the study though many had used regular cell phones and were familiar with texting. Mean participation in the diary study was 67 days (out of a total possible 84 days). There were a total of 6997 diary days; days that did not include a report of an interaction with a sex partner were not considered for subsequent analysis. This left 1606 diary days during which an interaction with a male sexual partner was reported—these were the event-contingent data, that is, data collected when the woman had an interaction with a sexual partner; of these 285 (285/1606; 18 %) included reports of anal intercourse. The women reported that their partner had been in jail or prison for 327 (20 %) of the partner interaction days.

Figure 1 shows the CONSORT flow chart for the participating women with respect to smart phones lost or stolen, and participants dropped because they did not meet study requirements [51]. The study recruited 184 women, not quite achieving the goal of 200. Because the study targeted women who were active illicit drug users, 35 women began the baseline interview, but were judged to be too high or incoherent to complete it; these women were not offered participation in the smart phone study. Six women refused to participate when the expectations associated with the study were explained to them, and one transgender woman was not enrolled due to being a biological male. Four women were not offered participation because they became hostile or abusive to research staff during the baseline interview.

A total of 46 participants were dropped from the study prior to the completion of the 12-week diary period because they did not meet study requirements. Nineteen participants were dropped from the study due to reporting to research staff that the smartphone had been stolen. Six participants reported that they had left the smartphone on a bus. Of the participants who completed the full 12 weeks of diary data submission part of the study, the majority completed the follow-up interview. A total of 84 follow-up interviews were completed 84/138; 61 %).

Table 2 shows the activities reported for those diary days that included male sex partner interactions. Table 3 presents the results of the multilevel logistic regression predicting daily anal intercourse with both the within- and between-subjects' parameters. With respect to the within-subjects' process, days on which a woman reported receptive heterosexual anal intercourse were also days on which she was more likely to report vaginal intercourse, using methamphetamine, using cocaine, giving oral sex, receiving oral sex and wanting sex. All variables were coded 1 = yes, 0 = no with the exception of relationship satisfaction and wanting sex, which were both measured on a Likert scale from 1 to 10, with higher scores

indicating more relationship satisfaction or greater wish for sex. In the between-subjects analysis, all of the within-subjects variables were significant except for giving oral sex. Time was not statistically significant either within or between women, suggesting that there was no increase or decrease in anal sex over time.

Figure 2 shows 30 examples of the between subjects variation in anal intercourse frequency over the course of the 12-week diary period. Each individual graph represents an individual participant in the study and we have included 30 examples to illustrate typical processes. The y-axis for each graph indicates 0 (anal intercourse was not reported) or 1 (anal intercourse was reported) and the x-axis is each day of the diary study. As can be seen from the graphs of our 30 examples, some participants had many days of diary completion as well as many days of anal intercourse (participant 236632); others had many days of diary completion and no anal intercourse (participant 540260) while others had varying amounts of participation and anal intercourse (participant 540699) or no anal intercourse reported over the days they completed the diary (544576).

Condom use for vaginal intercourse occurred for 27.5 % of the sexual encounters reported on the diaries and condom use was reported for 9 % of anal intercourse encounters; lubricant use was reported for 12.5 % of the anal intercourse encounters. Condom use for vaginal intercourse was significantly associated with condom use for anal intercourse ($\chi^2(1) = 181.62$, $p < .0001$) and with lubricant use for anal intercourse ($\chi^2(1) = 76.67$, $p < .0001$).

Discussion

The increasing availability of smartphones with sophisticated Internet and other capabilities has seen electronic diaries being used in a wide range of medical, clinical and behavioral research. Uses include capturing risk behaviors for sexually transmitted disease and HIV infection among HIV-negative [34] and HIV-positive individuals [20], estimating the association between physical symptoms and psychological variables [52, 53], describing the impact of social anxiety on sexual encounters [54], treatment adherence in cancer patients [41], and relapse prevention in drug abusers [55]. This is the first study we know of that used smartphones and Internet technology in a daily diary study for low-income illicit drug-using women.

We hypothesized a within-subjects process wherein participants who reported anal intercourse would also report use of at least one illicit drug on the same day. This hypothesis was supported. We were also able to get a much richer idea of the interplay of drug use and sex in the daily lives of these women. Anal intercourse days were also those days on which they were more likely to report a variety of other sexual behaviors, including oral and vaginal sex. This is consistent with other studies that have reported that anal intercourse is seldom an isolated sexual event, but takes place within the context of other sexual behaviors and is also associated with positive mood [33]. These findings are also consistent with work reported by Lorvick et al., who found that methamphetamine-using women received pleasure from both the drug use and concurrent sexual activity [1].

Previous cross-sectional studies of drug-use and anal intercourse found associations between these two behaviors. These studies were limited to conclusions that women who used methamphetamine, cocaine, or injected drugs such as heroin were also likely to report anal intercourse. But these associations may only have indicated that illicit drug use was a proxy or descriptor of a group of women who were more likely to have anal intercourse. The drug use in the cross-sectional studies may have only occurred many days, weeks or months before or after the anal intercourse. In the current study, we are now able to demonstrate that *the days on which women took cocaine or methamphetamine were also the days on which they had anal intercourse*. This is a major step forward in understanding the relationship between drug use and oral sex and the outcome of anal intercourse.

In many ways, our study participants were similar to those in the study by Freedman et al. [55]. In that study, homeless crack-using adults were given cell phones for a period of 2 weeks, during which they recorded craving and drug-using episodes. That study used a much shorter reporting time period than the current study, so loss of cell phones and lack of compliance was not as marked. However, it is clear from the discussion, that had the study gone on longer, many of the challenges we encountered in keeping the women enrolled in our study would have been manifested. The chaotic lives of the participants in our study, including lack of stable housing, drug use, lack of resources, and the challenges of simply getting through each day were factors in the high numbers of women who were dropped from the study because they reported the smart phones to be lost or stolen. Despite a research assistant being available Monday through Friday to answer questions and help with using the smart phone and data collection app in person and over the telephone, many of the women expressed frustration at the learning curve they experienced in using this new technology. We were told by the women that they were not sure whether the data were actually uploaded to the server when they pressed the “submit” button at the end of each diary entry and many telephone calls that occurred were participants calling into ensure that their data had been received and that they were on track for that week’s incentive. Most participants came in each week to get their cash incentive and this provided a good opportunity for research staff to check with participants about several issues, including whether the smart phone was working properly.

Most participants who completed the 12-week diary study completed the diary at least once per day. Many women who dropped out of the study after 2 months expressed that the necessity of completing the diary every day was burdensome. The increase in the weekly incentive from $5 to $20 for weeks 9–12 was the reason many of the women completing the study gave for their continued participation. Without that additional cash incentive, it is likely that completion of the full 12 weeks would have been lower than it was. For many women, the study was received very well. They were very happy to have the opportunity to have the smart phone and to become familiar with its functionality. Many expressed that they had seen or heard about smart phones, but that owning one was beyond their means and they were thrilled to have the opportunity offered by the study. One unanticipated benefit for many of women in the study was the camera that was available on all of the phones. Many women in the study had criminal justice involvement and had lost custody of their children and only saw them on court-monitored visiting days. These women were able to photograph

their children using the smart phones and had the pictures on the phones to remind them of their children on days they did not have visits.

In conclusion, this study demonstrated the feasibility of using smart phones for data collection with a sample of drug-using women. Variations in anal intercourse frequency provide insight into this risky behavior that may inform the development of interventions to reduce the risks in the context of illicit drug use.

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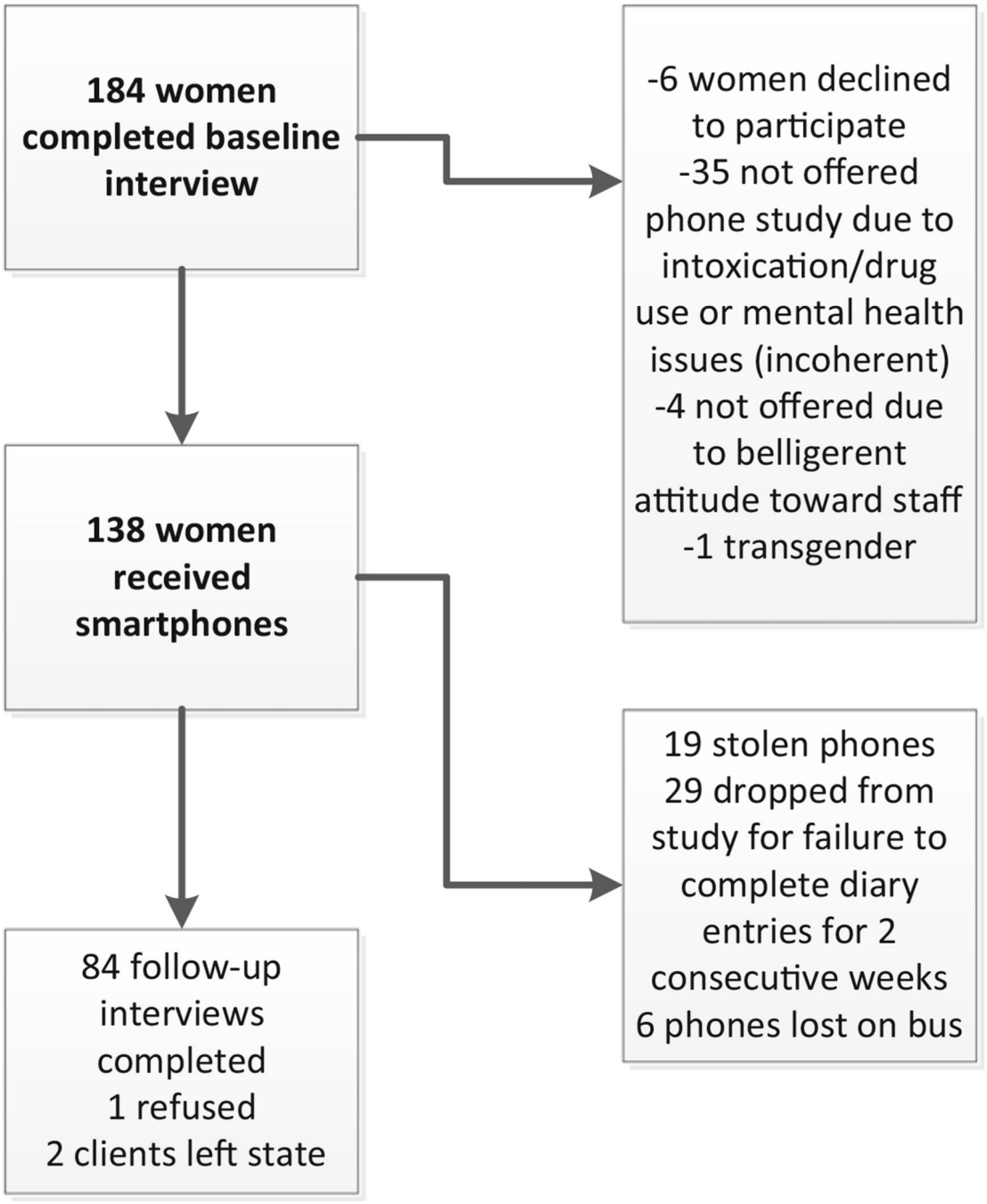

Fig. 1.
Flow chart of the daily diary study

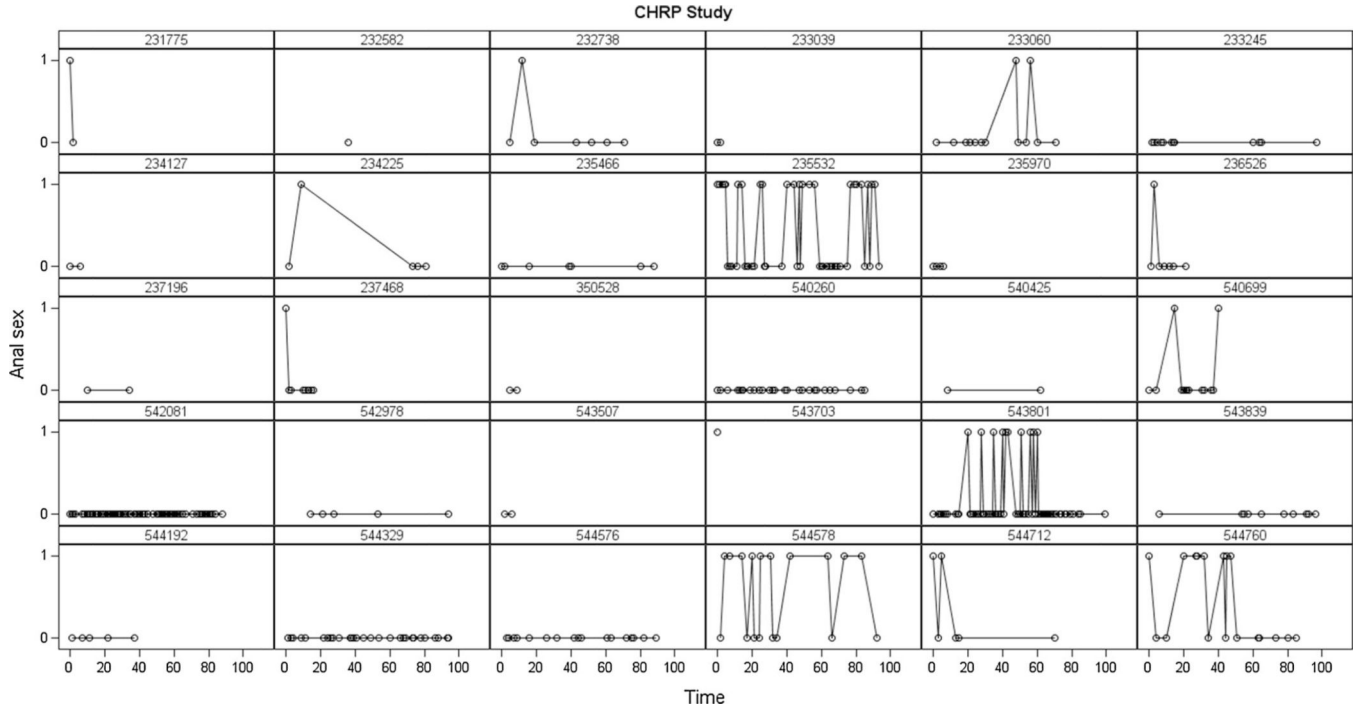

Fig. 2.

Between-subjects variation in anal intercourse frequency

Table 1

Women enrolled into the daily diary study (*N* = 138)

Variable	*N* (%)
Ethnicity/race	
African American	79 (57)
White, non-Hispanic	26 (19)
White, Hispanic	23 (17)
Asian/Pacific Islander	2 (1)
Native American	2 (1)
Other, mixed race	6 (4)
Education	
Less than high school	50 (36)
High school or equivalent	53 (38)
Some college	23 (17)
College graduate	6 (4)
Monthly income	
<$500	75 (57)
$500–$999	41 (31)
>$999	22 (16)
Sexually abused as a child or adolescent	73 (54)
Currently live with other adult friend or family	54 (41)
Sources of income	
Paid job, salary	16 (12)
Welfare or public assistance	60 (46)
Spouse, family or friend	42 (32)
Prostitution, sex trading	26 (20)

Table 2

Total diary days with sexual partner activities before/after any sex (*N* = 1606 dairy days)

Variable	% Yes
Vaginal intercourse	1272 (79)
Received oral sex from partner	984 (61)
Gave oral sex to partner	964 (60)
Smoked cigarettes	814 (51)
Used alcohol	621 (39)
Watched pornography	509 (32)
Went to hotel/motel	499 (31)
Used marijuana	505 (31)
Condom use vaginal intercourse	436 (27)
Anal intercourse	285 (18)
Argued or fought	269 (17)
Lubricant use anal intercourse	194 (12)
Used a sex toy	198 (12)
Condom use anal intercourse	139 (9)
Used crack	105 (7)
Used methamphetamine	120 (7)
Used cocaine (powered)	43 (3)
Used heroin	13 (<1)

All variables coded 1 = yes, 0 = no. Sample size is number of diary days when an interaction with a sexual partner occurred

Table 3

Multilevel logistic regression with random intercept and fixed slope for female predictors of daily anal intercourse

	Coefficient (SE)	***p***	**OR**	**95 % *CI* of *OR***	
				Lower	**Upper**
Model term-within					
Intercept	−3.09 (032)	<0.001	–	–	–
Time	−0.01 (0.01)	0.50	0.99	0.984	1.009
Want sex (within)	0.33 (0.14)	0.02	1.39	1.056	1.837
Vaginal sex (within)	1.29 (0.18)	0.04	3.65	1.039	12.791
Receive oral sex (within)	1.43 (0.41)	<0.001	4.19	1.889	9.287
Give oral sex (within)	0.71 (0.35)	0.045	2.02	1.016	4.032
Meth use (within)	0.64 (0.32)	0.047	1.90	1.008	3.584
Cocaine use (within)	1.49 (0.61)	0.014	4.46	1.357	14.641
Model term-between					
Want sex (between)	−0.46 (0.34)	0.024	0.631	0.324	1.229
Vaginal sex (between)	1.86 (0.94)	0.047	6.42	1.018	40.528
Receive oral sex (between)	3.91 (0.90)	<0.001	49.89	8.550	291.196
Give oral sex (between)	0.49 (0.70)	0.485	1.63	0.413	6.436
Meth use (between)	2.10 (0.93)	0.024	8.16	1.319	50.541
Cocaine use (between)	4.82 (1.98)	0.015	123.96	2.559	6002.912
Random effect covariances	Estimate (SE)	*z*	*p*	*95 % CI*	
				Lower	Upper
Level-2 (between-person)					
Intercept variance	3.22 (1.06)	3.03	0.002	1.138	5.298

Interclass correlation for binary daily anal intercourse outcome is .58 (binary daily anal intercourse outcome is 1 = yes, 0 = no)